DOCUMENT RESUME

ED 282 922 TM 870 340

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TITLE The Factor Structure of the Jewish Employment and Vocational Service Work Samples.
PUB DATE Apr 87
NOTE 20p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, DC, April 20-24, 1987).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Measurement; *Construct Validity; Correlation; Disabilities; Factor Analysis; Factor Structure; Measurement Techniques; *Psychometrics; Secondary Education; Test Use; *Vocational Evaluation; *Work Sample Tests
IDENTIFIERS Communality; General Factor (Intelligence); *Jewish Employment and Vocational Service System; Specificity

ABSTRACT

The purpose of the study was to investigate the construct validity of the Jewish Employment and Vocational Service (JEVS) work samples. The specific objectives were: (1) to investigate the factor structure of the JEVS work samples; (2) to determine which work samples were good measures of general ability; and (3) to identify the work samples that possess trait specificity. One hundred twenty educationally handicapped students were administered 15 JEVS simulated work samples. Intercorrelations among raw scores of the work samples were factor analyzed utilizing principal axis factoring. Sixty-seven percent of the correlations were significant, indicating that work samples which emulate similar tasks share common abilities. A two factor rotated solution was found to have a simple structure and the most meaningful interpretation. Factor one was verbal comprehension and factor two was called perceptual organization. Six work samples showed 50 percent or higher of the total variance and the specific variance exceeded error variance. Two work samples had a moderate percentage of trait specificity. The other seven work samples did not meet the requirements for trait specificity. Results imply that caution should be used when using work samples for analyzing specific trait abilities. In addition sub-batteries of work samples might be used to assess the readiness skills or general ability and orientation toward vocational education instead of specific traits. (JAZ)

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The Factor Structure of the Jewish Employment and Vocational Service Work Samples

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Paper presented before the American Educational Research Association, April, 1987 held in Washington, D.C. Comments on the manuscript are welcome and should be directed to the author at (201) 431-3773.

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ABSTRACT

The study investigated the factor structure of fifteen JEVS (Jewish Employment and Vocational System) work samples, the proportion of variance attributable to the general factor, "g"; communality; and the feasibility of identifying a unique ability tested by each work sample. The results indicate that performance on a work sample is due to abilities shared with other work samples rather than attributed to unique abilities.

THE FACTOR STRUCTURE OF THE JEWISH EMPLOYMENT AND VOCATIONAL SERVICE WORK SAMPLES

Assessment of students with educational handicaps utilizing simulated work samples has been considered a valid vocational assessment strategy (Albright, 1980; Nadolsky, 1985; Thornton & Byham, 1982) because of convenience, ease of use, and "real work" appearance (Roberts, Doty, Santleben, & Tang, 1983; Stodden, 1980; Waugh, 1982). The work sample results are defined in terms of traits that are related to successful performance of a specific work task. The student's traits are then matched with similar traits of a given job.

Recently, assessors realized that the results of performance tests yield data that is also useful in identifying cognitive measures as well as performance levels of an occupational competency. As a result, an increasing number of commercial work samples have evolved into a psychometric instrument for examining these abstract traits (Peterson, 1986).

Although both the cognitive and performance tests share a common result--the evaluation of specific skills and abilities--a dichotomy exists in the development of both processes. The foundation of cognitive tests emphasizes objectivity through reliability and validity. Performance tests capitalize on trait identification. Although the evolution is different, the two testing processes have become psychometric instruments and should duly meet acceptable standards of reliability and validity

(Andrelini & Zittel, 1983; Neff, 1966).

Theoretical Framework

Attempts have been made to provide objective data on the specific traits tested by commercial work samples (Chan, Parker, Dial, Lam, & Carter, 1986; McCarron & Ludlow, 1982; Packard, Henke, & McCollum, 1976; Tryjankowski, in press) through the exercise of construct validation. Construct validity of a test is the extent to which the test measures a specific trait (Anastasi, 1982). It is imperative to identify the specific trait that the test is measuring if the outcome of the procedure is to be used for decision making.

Although research has begun to determine the validity of assessing cognitive traits with simulated work samples, no single piece of evidence is sufficient to establish the construct validity of a measurement procedure. A series of studies that examine every reasonable interpretation of the results of measurement is necessary before a construct validity claim is adequately supported.

There are various techniques that contribute to construct validation. One of these is factor analysis whose common objective is to simplify the description of behavior by reducing the number of variables to a few common factors or traits. By subjecting the results of work samples to a factor analytic technique, the resulting factor structure could warrant sufficient use of simulated work samples as a psychometric

instrument.

Purpose

The purpose of the study was to investigate the construct validity of the JEVS work samples. Specifically, the objectives of the study were threefold, as follows:

1) Investigate the factor structure of the JEVS (Jewish Employment and Vocational Service) work samples.

2) Determine which work samples are good measures of general ability.

3) Identify the work samples that possess trait specificity.

The JEVS work samples were chosen for the study because they are widely used to make decisions centered around occupational direction of both normal and educationally handicapped students and there is insufficient empirical evidence of construct validity.

Methodology

Subjects

The subjects in this study totaled 120 (101 male; 19 female) educationally handicapped students who attended the Prevocational Assessment Program at Monmouth County Vocational School District, Career Center, Freehold, New Jersey. The students were classified in accordance with P.L. 94-142 (Education of all Handicapped Children Act of 1975). Chronological age of the students ranged from 13-17 (Mean=15.1). Intelligence level for

the sample was within the normal range (Mean=94.0). 75% of the subjects were classified as learning disabled. The remaining 25% were classified as emotionally disturbed or educable mentally retarded. Subjects who were multiply-handicapped were not included in the study.

Measures

All subjects were administered fifteen JEVS (Jewish Employment and Vocational Service) simulated work samples a part of the routine assessment process. The fifteen work samples were: Signmaking, Union Assembly, Lock Assembly, Belt Assembly, Washer Assembly, Nail and Screw Sort, Adding Machine, Telephone Assembly, Filing by Number, Resistor Reading, Pipe Assembly, Grommet Assembly, Nut Packing, and Rubber Stamp. A simple scoring method which counted the total number of steps that were performed adequately was used. Therefore, each step was either correct or entirely incorrect so that one error was counted per step.

Statistical Analysis

Intercorrelations among raw scores of the fifteen JEVS work samples were factor analyzed utilizing principal axis factoring (squared multiple correlations as final estimates of communalities). The Kaiser-Guttman (eigenvalues greater than 1.0) rule (Kaiser, 1958) and Cattell's scree test (Cattell, 1968) were used to determine the number of factors to be retained. The

solution was rotated by the varimax (orthogonal rotation) method.

Following the determination of the factor structure, the pattern of loadings on the initial factor matrix was examined to determine the relationship of each work sample to general ability, commonly known as the "g" factor. The communality of each work sample was then subtracted from the split-half reliability coefficients to determine the proportion of the variance that is specific to each work sample, also known as trait specificity. The relationship of each work sample to general ability and its specificity are directly related to the use of works samples as a psychometric instrument for measuring cognitive abilities within an occupational context.

Results

The examination of the correlation matrix (Table 1) indicates that 67% of the correlations were significant ($p<.01$). This results generates evidence that the JEVS work samples which emulate similar tasks would tend and share common abilities.

The intercorrelation matrix was submitted to a principal axis factor analysis. A scree plot of eigenvalues suggested a range of one to four factors. In order to ensure a parsimonious structure, one-, two-, three-, and four factor solutions were rotated by the varimax method. The two factor rotated solution (accounted for 51.4% of the total variance) was observed to have a simple structure and the most meaningful interpretation. Table 2 represents the two factor varimax rotated solution.

Table 1
Intercorrelation Matrix for the Fifteen JEVS Work Samples

Work Sample	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Signmaking														
2. Union Assembly	43													
3. Lock Assembly	38	32												
4. Belt Assembly	44	51	35											
5. Washer Assembly	57	47	27	50										
6. Budgette Assembly	58	46	28	49	68									
7. Nail and Screw	18	05	27	16	17	14								
8. Adding Machine	50	40	29	39	42	52	07							
9. Telephone Assembly	49	45	40	40	54	51	20	45						
10. Filing by Number	44	41	14	38	37	37	00	41	35					
11. Resistor Reading	-08	05	09	13	-11	-17	05	-28	02	02				
12. Pipe Assembly	37	31	36	36	38	38	28	33	41	10	-02			
13. Grommet Assembly	59	46	38	44	65	71	17	61	57	41	-21	42		
14. Nut packing	44	41	23	43	52	54	09	47	49	27	-18	22	55	
15. Rubber Stamp	-06	08	05	12	01	11	-03	00	20	-08	11	04	05	18

Note. Decimal points have been eliminated.
Underlined correlations are significant ($p<.01$)

Table 2
Varimax Factor Loadings of JEVS Work Samples

Work Sample	Factor 1	Factor 2
Signmaking	63	31
Union Assembly	51	40
Lock Assembly	32	44
Belt Assembly	45	53
Washer Threading	71	27
Budgette Assembly	80	18
Nail and Screw Sort	13	26
Adding Machine	73	03
Telephone Assembly	53	42
Filing by Number	46	18
Resistor Reading	-30	45
Pipe Assembly	39	36
Grommet Assembly	84	20
Nut Packing	63	16
Rubber Stamp	01	17
Eigenvalues	7.2	1.5
Percent of Variance Explained	42.6	8.8
Cumulative Percent of Variance Explained	42.6	51.4

Factor I--Verbal Comprehension. The first factor accounted for 42.6% of the total variance. Grommet Assembly, Washer Threading, Adding Machine, and Budgette Assembly had the highest loadings on this factor. The magnitude of these loadings was generally in the .84-.71 range. Signmaking, Telephone Assembly, Union Assembly, and Nut Packing had moderate loadings (.51-.63). All of these work samples required oral instructions prior to performance. Thus, Factor 1 was chosen as a verbal comprehension factor.

Factor 2--Perceptual Organization. The second factor accounted for 8.8% of the total variance. Lock Assembly, Resistor Reading, and Belt Assembly (.53-.45) were in the

moderate to low range. Each of these work samples required the task of putting parts together to get a meaningful whole. Thus, factor 2 was called perceptual organization.

Work Samples as Measures of General Ability

The method used to assess a general ability factor was the large unrotated first principal factor purported by Kaufman (1975) who considers each work sample's loading to be indicative of its measurement of general ability. By squaring the coefficients, the proportion of each work sample's variance that may be attributed to general ability is obtained. The summary below identifies the categories of Good, Fair and Poor measures of general ability found in the work samples. In this study, good measures of ability were in the range of 49%-61%; fair measures, 37%-48%; and poor measures 0%-24%.

Good Measures of General Ability	Fair Measures of General Ability	Poor Measures of General Ability
Grommet Assembly (.87)	Telephone Assembly (.69)	Pipe Assembly (.49)
Budgette Assembly (.82)	Nut Packing (.65)	Filing by Number (.49)
Washer Threading (.76)	Belt Assembly (.61)	Lock Assembly (.46)
Signmaking (.70)	Union Assembly (.61)	Nail and Screw (.21)
Adding Machine (.70)		Rubber Stamp (.07)
		Resistor Reading (-.12)

Table 3
Variance Components of the JEVS Work Samples

Work Sample	Common Variance	Specific Variance	Error Variance	(r)
Signmaking	52	24	24	76
Union Assembly	42	40	18	82
Lock Assembly	30	51	19	81
Belt Assembly	49	08	43	57
Washer Assembly	57	09	34	66
Budgette Assembly	68	02	30	70
Nail and Screw Sort	09	52	39	61
Adding Machine	54	19	27	73
Telephone Assembly	51	38	11	89
Filing by Number	24	51	25	75
Resistor Reading	29	65	06	94
Pipe Assembly	28	66	06	94
Grommet Assembly	79	00	21	79
Nut Packing	42	05	53	47
Rubber Stamp	03	77	20	80

Note. The reliability coefficients are split-half correlations corrected by the Spearman-Brown formula. The data for the reliability coefficients are based on the subjects described in the study.

Work Sample Specificity

In order to determine the feasibility of interpreting unique abilities or traits attributed to a particular work sample, Kaufman (1979) suggests that uniqueness is sufficient if the specific variance constitutes 25% or more of the total variance and it exceeds the error variance. Squared multiple correlations, derived from factor analysis, were used as estimates of common variance (Silverstein, 1976). The common variance of each work sample was subtracted from the reliability coefficients of each work sample to determine the proportion of variance that is specific to each work sample.

Six work samples, Lock Assembly, Nail and Screw Sort, Filing by Number, Resistor Reading, Pipe Assembly, and Rubber Stamp

found to have 50% or higher of the total variance and the specific variance exceed the error variance. Two work samples, Union Assembly and Telephone Assembly had a moderate percentage of trait specificity (38-40%) The seven remaining work samples did not meet the requirements for trait specificity. The following categorizations summarize the degree of trait specificity found in the work samples:

Ample Specificity	Adequate Specificity	Inadequate Specificity
Lock Assembly	Telephone Assembly	Grommet Assembly
Nail and Screw	Union Assembly	Belt Assembly
Filing by Number		Washer Assembly
Resistor Reading		Budgette Assembly
Rubber Stamp		Adding Machine
Pipe Assembly		Nut Packing
		Signmaking

Discussion

Construct validity is determined by the degree to which a test measures discrete, independent abilities. In this study, 67% of the correlations of fifteen JEVS work samples were significant ($p<.01$). Since there were a high number of significant correlations between work samples, the presence of fifteen independent, unique abilities measured by the work samples is suspect. The results support the assumption that work samples which emulate similar tasks tend to be highly intercorrelated and share common abilities.

The results of the principal axis factor analysis followed by varimax rotation sheds more light on the question of construct

validity in terms of trait specificity. A varimax rotated solution resulted in a two factor pattern. Factor 1 was chosen as a verbal comprehension factor and Factor 2 was called perceptual organization. The emergence of a two factor pattern further confirms the assumption that the work samples are not testing fifteen discrete traits.

The factor analysis technique was also used to determine the degree of specificity found in each work sample. Of the fifteen work samples, only six exhibited ample specificity to warrant the conclusion that a work sample tests a unique and independent trait. These results should serve as a caution to vocational evaluators who use work samples results to analyze specific trait abilities because, with some exception, performance on the work samples is due to abilities shared with other work samples than due to uniqueness.

Alternative Approaches to the Use of Work Samples for Assessment

Principal axis factoring followed by a varimax rotation resulted in a two factor structure for fifteen JEVS work samples. Although trait identification specific to each work sample was not evident, two alternative approaches to the use of the work samples as an assessment instrument evolved: a) assessment in terms of two "vocational readiness" skills, namely, verbal comprehension and perceptual organization; and 2) use of the works samples as an indicator of general ability within an

occupational environment.

Assessment of Readiness Skills. In terms of educational implications, the work samples could be used to assess two readiness skills, verbal comprehension and perceptual organization. The work samples characterized by each factor could formulate a battery of subtests under the headings of verbal comprehension and perceptual organization. The advantages of this model are twofold: 1) the results of the work samples can be viewed in terms of general "readiness" skills for occupational direction; and 2) the battery is administered within a vocational environment using occupationally-oriented tools rather than using academic tools within a clinical setting.

Work Samples as an Indicator of General Ability. A battery of commercial work samples characteristically includes a large number of specific work sample modules. For instance, there are twenty-eight work samples in the JEVS system. Administration of the works samples is time consuming and expensive. This study indicated that five work samples, Grommet Assembly, Budgette Assembly, Washer Threading, Signmaking, and Adding Machine are estimates of a good measure of general ability within an occupational environment. A more efficient method would involve the use of these six work samples to determine the level of general ability or orientation toward vocational education instead of the student performing on all the work samples. The performance results would provide insight into a student's general ability or orientation toward pursuance of occupational

direction.

Besides using the work samples as a psychometric instrument to determine general abilities and readiness skills within the vocational realm, the test results offer insight into the areas in which a handicapped or normal person may experience problems and possibly, failure if exposed to occupational training. If a student does not possess a minimum level of ability, alternative teaching strategies and/or compensatory techniques can be introduced into the vocational shop to facilitate successful achievement of occupational tasks and prevent the possibility of failure.

Implications

The study gave evidence to support the premise that simulated work samples could be used in terms of assessing general abilities rather than trait specificity. However, this study is preliminary, at best, in determining construct validity of the JEVS work samples. Subsequent research is necessary to: 1) determine the stability of a two factor structure; 2) identify the unique traits of the six work samples found in this research to have ample specificity; 3) conduct construct validity research on the other commercialized stimulated work samples; and 4) examine the factor structure of different populations across various age groups. This study focused on a handicapped population between the ages of 13-17.

Consideration of these above-stated recommendations is

necessary before a construct validity claim is adequately supported for the JEVS or any of the commercialized work samples available for assessment of occupational skills. This research provides the first step in the process of construct validation of the JEVS work samples.

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